



NAVAL MEDICAL RESEARCH UNIT DAYTON, OHIO



Science Update

Volume 1, Issue 4

Fall 2011

NAMRU-D MISSION:

To maximize warfighter performance and survivability through premier aeromedical and environmental health research by delivering solutions to the field, the Fleet, and for the future.

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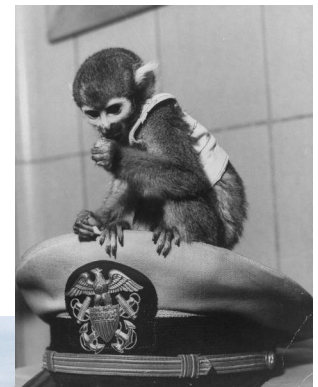
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Seventy Years of Naval Aeromedical Research Excellence Moves to Dayton, OH



Top left: NAMRL Headquarters Building, 1953. Top right: Miss Baker, 1959.
Bottom: NAMRL acceleration facility (1950s-2005) and Headquarters from 2005-2011.

By Dr. Richard D. Arnold

Naval Air Station Pensacola has been home to aeromedical research in the naval services since 1939. While the aeromedical research laboratory stood under several names in its history, Naval Aerospace Medical Research Laboratory (NAMRL) is the name most widely recognized. NAMRL was at the forefront of many of Naval Aviation's formative scientific endeavors, from setting the standards for naval aviator selection, to playing an integral part in the space race alongside NASA. Early contributions to the space program under the guidance of long-time research director Dr. Ashton Graybiel included roles in the

development of the first space suit and the transdermal scopamine patch. In addition, NAMRL investigators conducted critical investigations into space survivability and radiation exposure. The first primate to survive space flight, Miss Baker, was a NAMRL squirrel monkey. However, NAMRL's primary focus has always been on Fleet aeromedical issues. For example, to facilitate safe, portable, and effective hypoxia familiarization for pilots and aircrew, NAMRL scientists designed the Reduced Oxygen Breathing Device (ROBD). The ROBD has not only significantly changed the way Naval aircrew train, but

other U.S. and international services and civilian aviation agencies have adopted its use. Another milestone invention was a novel acoustic dampening material designed to address the ever-present problem of intense noise in the aviation environment. Both of these inventions garnered the prestigious Federal Laboratory Consortium Award for Technology Transfer. More recent highlights include two award-winning projects, one involving an intranasally-administered countermeasure for motion sickness, and the other, an oral countermeasure for fatigue, both of which received the Surgeon General's Research and Development Procedural Advancement Award.

(Continued on page 2)

Jet Fuel and Hearing Loss

By LT Pedro A. Ortiz

Hearing loss is one of the most prevalent service-connected disabilities for veterans of the armed forces, with noise-induced hearing loss being a major military operational health hazard. Although widespread hearing conservation measures have been adopted, noise-induced hearing loss is as high as 20-30% in the military. Noise exposure standards have historically been based on the range of human auditory sensitivity and exposure duration; however, recent research has established that simultaneous and even successive exposure to noise and specific chemical agents, including those found in jet fuel, can potentiate noise-induced hearing loss or produce additive effects. In a project funded by the Air Force Surgeon General, researchers from NAMRU-Dayton, the Air Force 711 Human Performance Wing/RHPBA and Jerry Pettis Me-



ATLANTIC OCEAN (April 30, 2008) Shooters launch an F/A-18F Super Hornet from a catapult during flight operations aboard the aircraft carrier USS Theodore Roosevelt (CVN 71). U.S. Navy photo by Mass Communication Specialist Seaman John Suits (Released).



PACIFIC OCEAN (Aug. 8, 2011) Airman Alexander Filipponi carries a refueling hose after filling an MH-60S Sea Hawk helicopter aboard the Nimitz-class aircraft carrier USS John C. Stennis (CVN 74). U.S. Navy photo by Mass Communication Specialist 3rd Class Benjamin Crossley (Released).

morial VA Medical Center have collaborated to determine if there is an association between jet fuel exposure and noise-induced hearing loss. The studies exposed rats to non-damaging “white” noise and jet fuel, both separately and in combination. While neither noise nor jet fuel alone had a significant effect on auditory function, significant dose-related impairment of auditory function was observed in rats co-exposed to noise and a high dose of jet fuel. Although the studies were performed with Jet Propulsion (JP)-8, they will likely need to be expanded to JP-5, as well as the new battery of alternative jet fuels awaiting approval for military use. Collectively, these results will allow a more accurate evaluation of exposure standards for the co-exposure of jet fuel and noise. This in turn will lead to significant savings due to decreased health care costs and the retention of specialized personnel, as well as savings due to reductions in long term health care and support for those leaving military service.

Naval Aeromedical Research Moves to Ohio (continued from page 1)

As a testament to its continued excellence in research, in June 2011 NAMRL was awarded the Meritorious Unit Commendation (MUC) for consistently demonstrating meritorious achievements above and beyond mission requirements. September 2011 marks the end of an era. NAMRL's official disestablishment at NAS Pensacola will mark the completion of its BRAC-directed relocation to Wright-Patterson AFB, Ohio – a move from the “Cradle of Naval Aviation” to the “Birth Place of Aviation”. Combining with the former Environmental Health Effects Laboratory (EHEL), NAMRL's mission and legacy will continue as part of Navy Medicine's newest research command, Naval Medical Research Unit – Dayton, a constituent of the new DoD Aeromedical Joint Center of Excellence at Wright-Patterson AFB. This new center provides NAMRU-D investigators with unique research devices in state-of-the-art laboratories to address a wide range of operational requirements. The new command is fast becoming a cornerstone of the new DoD Center of Excellence at WPAFB and Navy Medicine's premier aeromedical and environmental health research laboratory. This next page in NAMRL's history is the beginning of new possibilities, new research, and a new investment by Navy Medicine in the protection of our warfighters.

NAMRU-D Investigates Health Risks to Troops from Burn Pit Emissions

By CDR Daniel Hardt

Open 'burn pits' have been used extensively in the Middle East by our Armed Forces to dispose of large quantities of solid waste [generated at a rate of 10 lbs per person per day]. This method of disposal has drawn considerable criticism recently on concerns that personnel are exposed to smoke containing potentially toxic chemical compounds. Several hundred (former and active) military members claim to have been sickened by smoke emitted from "burn pits", both from occupational and incidental exposures; yet evidence remains anecdotal and requires further scientific evaluation.

In February 2011 NAMRU-D conducted a series of three test burns within a pilot-scale surrogate 'burn pit' facility, using a historically representative mixed solid waste stream to simulate the waste consumed in 'burn pits' in Iraq and Afghanistan between 2006 and 2009. The Battelle Memorial Institute's Ambient Breeze Tunnel was used to maintain open burn environmental conditions, while directing the plume of smoke into analytical instruments, collection devices, and exposure chambers containing human airway and lung cell cultures. Combustion emissions were measured both inside the tunnel and from the manifolds inside the mobile laboratory to ensure representative exposure. A comprehensive gas and particle characterization of emissions was generated, which included: sulfur dioxide; carbon monoxide; carbon dioxide; volatile organic compounds; total hydrocarbons; poly-aromatic hydrocarbons; dioxins; furans; carbonyl compounds; total particle mass; particle composition and particle size distribution.

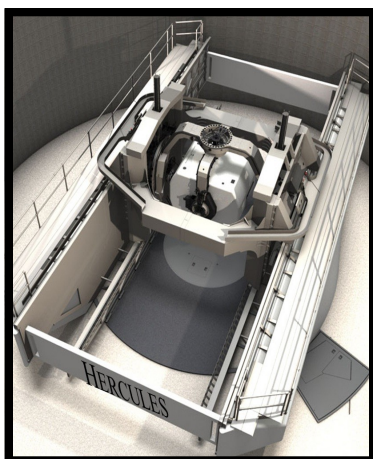
NAMRU-D intends to conduct a comprehensive toxicological study of the health effects of inhalation exposures to open combustion emissions. These preliminary data are an essential first step towards effectively designing future animal studies, and are currently being used by NAMRU-D's Tri-Service Partners to develop more effective industrial hygiene programs and engineering controls in-theater.



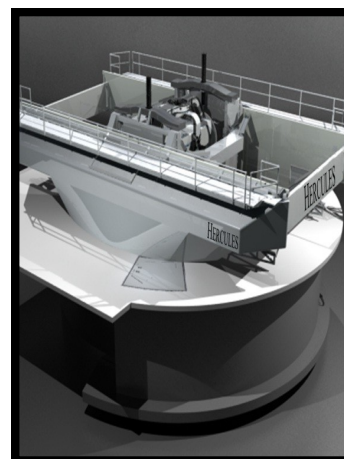
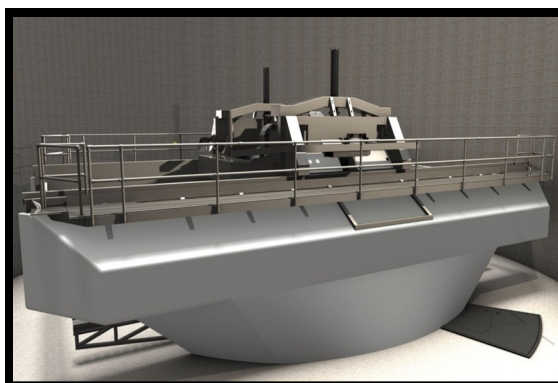
Top: Burn-Pit Ops at Joint Air Base Balad, Iraq.

Bottom: Combustion of Mixed Solid Waste in the Ambient Breeze Tunnel.

Artist renditions of the completed Disorientation Research Device



The DRD is scheduled to be complete by Spring of 2012.



NAMRU-D and AF Scientists Submit Collaborative Research Proposals

By Dr. Jeffrey Phillips and
Dr. Lynn Caldwell

Scientists from NAMRU-D, the Air Force 711th Human Performance Wing (711 HPW), and the Air Force Institute of Technology (AFIT) recently submitted several joint research proposals for funding from the Air Force Surgeon General's office (AFSG), which leverage resources and scientific expertise to address military operational problems. The proposal topics include spatial disorientation, fatigue countermeasures, and hypoxia. Each proposal addresses a specific issue by capitalizing on the unique resources of the BRAC-created Joint Center of Excellence for Aeromedical Research, Education, and Training housed at the new MGen Harry G. Armstrong complex on Wright-Patterson Air Force Base. Unique capabilities include: state-of-the-art fatigue and hypoxia laboratories, high-altitude chambers, and several one-of-a-kind devices designed to investigate specific spatial disorientation phenomena. Three of the proposals submitted to the 711 HPW for review were accepted and sent forward for final review by AFSG. The fourth proposal was accepted for funding without further review.

The first proposal submitted by NAMRU-D, 711 HPW, and AFIT, will be a collaborative approach with a main objective of deter-

mining the effects of inadequate sleep on spatial disorientation (SD) incidence and simulated flight performance. The overall goal of the study is to reduce aviation mishaps through heightened awareness of specific SD risks during night operations. In the second proposal, NAMRU-D and the Air Force Human Performance Directorate will join efforts to assess the combined effects of modafinil and an over-the-counter (OTC) alertness aid on cognitive and physical performance of airmen over the course of several days with restricted sleep. The results of this study will allow more flexible and effective use of prescription and OTC alertness-enhancing substances during military operations. The third proposal submitted, a collaboration between NAMRU-D and the U.S. Air Force School of Aviation Medicine (USAFSAM), will focus on developing a system to detect low O₂ concentrations and the presence of volatile organic compounds in air mixtures delivered by On Board O₂ Generating Systems (OBOGS). This effort aims to eliminate pilot in-cockpit loss of consciousness associated with malfunctioning OBOGS units. Lastly, the funded proposal submitted by NAMRU-D and USAFSAM will investigate the suitability of using the Reduced O₂ Breathing Environment (ROBE), a normobaric hypoxia training environment, as a

proxy to high altitude chambers for flight crew hypoxia training. If successful, the ROBE will provide a significant improvement to safety and cost effectiveness over current methods.

Proposals are currently being reviewed by the AFSG Office and decisions are expected as early as October. Scientists from NAMRU-D are energized by the collaborative environment surrounding the Joint Center. This new campus allows Navy and Air Force scientists to leverage respective expertise, experience, and capabilities to solve common aeromedical issues that span across the military services.



Research participant performs a color vision task while enduring hypoxic conditions.

NAMRU-D Participates at the 2011 Advanced Technology Applications for Combat Casualty Care (ATACCC) Conference

By Dr. Lynn Caldwell

The 2011 Advanced Technology Applications for Combat Casualty Care (ATACCC) Conference was held 15-18 August in Fort Lauderdale, FL. This annual meeting, sponsored by the Combat Casualty Care Research Program, is the military's premier scientific conference and a major venue for scientists involved in both clinical and scientific activity related to military medical interests. Past conferences have focused on Army medicine; however, this year's meeting was the intended to join the efforts of Army, Navy, and Air Force members and to share their medical expertise. More than 1300 people from both military and civilian institutions across the United States attended the meeting. COL Hack, Director of the U.S. Army Combat Casualty Care Research Program, opened the conference Monday morning. Presentations throughout the week focused on human performance, dietary supplements, combat-related Post-traumatic Stress Disorder (PTSD), Traumatic Brain Injury (TBI), and wound-related issues such as infection and shock.

Dr. Richard Arnold, NAMRU-D Aeromedical Research Director, presented results from research completed over the past year on individual differences in fatigue resistance during chronic



PORTSMOUTH, Va. (Dec. 2, 2010) A chief hospital corpsman instructs Reserve component hospital corpsmen. U.S. Navy photo by Mass Communication Specialist 2nd Class Ron Kuzlik (Released).

and acute sleep restriction. The presentation was well received and elicited numerous questions from the audience. CDR Simmons, NAMRU-D Executive Officer, attended the meeting as well. She had many occasions to discuss NAMRU-D's new laboratory facility with various attendees, opening opportunities for future collaborations with Army, Air Force, and Navy scientists. Overall, the meeting served as an excellent venue for sharing NAMRU-D current and future research, meeting other scientists, and discussing future research needs in human performance.

NAMRU-DAYTON Solidifies Local Scientific Research Connections



As researchers at the Naval Medical Research Unit-Dayton (NAMRU-D) transitioned existing in-house research to Wright-Patterson Air Force Base (WPAFB) this spring, NAMRU-D leadership also sought to establish new connections with scientific institutions in the Dayton region. These connections were seen as vital in realizing BRAC's aim of synergistically operating within the new Center of Excellence and Dayton region and achieving the goal of enhanced mission accomplishment through partner-associated growth.

In an effort to cultivate Air Force partnerships, NAMRU-D staff met with leadership from the U.S. Air Force School of Aerospace Medicine (USAFSAM) and the Air Force Institute of Technology (AFIT) to discuss emerging topics of research interest. Discussions with USAFSAM's research leaders included topics of how NAMRU-D might aid USAFSAM in provid-

ing current and innovative technologies for their students, several potential research collaborations, and possible future aeromedical research partnerships. These discussions led to the submission of four joint research proposals to an Air Force Surgeon General sponsored Broad Agency Announcement (BAA).

Another series of meetings was conducted with representatives from the Air Force Institute of Technology (AFIT). AFIT recently created Human Systems/Factors specialty tracts within the Systems Engineering graduate programs, an area of expertise for several NAMRU-D researchers. Conversations with the AFIT Human Systems Integration Program Chair and Lead Professor explored the possibility of joint research efforts that may provide benefit to the AFIT student population and the potential for NAMRU-D staff to participate as guest lecturers for their newly developed program. NAMRU-D also

reached out to several Dayton area university research institutes including the University of Dayton Research Institute (UDRI) and Wright State Research Institute (WSRI). NAMRU-D and UDRI currently have two collaborative research studies on-going and recently submitted two joint project proposals for funding. NAMRU-D hopes to form similar connections with WSRI, which develops innovative technologies to be employed by government and commercial agencies.

As NAMRU-D continues to grow and becomes an increasingly active contributor within the Dayton scientific community, it expects the number of collaborations with other scientific institutions within the region to increase significantly. These collaborations will strengthen NAMRU-D's capability and capacity to innovate and create better solutions for the issues that face our men and women of the armed forces.

NAMRU-D Presentations & Products

- Chandler, J. F., Phillips, J. B., & Arnold, R. D. (2011, August). *Individual differences in fatigue resistance during chronic and acute sleep restriction*. Presentation given at the Advanced Technology Applications for Combat Casualty Care 2011 Conference, Fort Lauderdale, FL.
- Chandler, J. F., Horning, D. S., Arnold, R. D., Phillips, J. B., Horak, D. S., & Taylor, D. L. (2011). *The use of commercial flight simulation software as a psychometrically sound, ecologically valid measure of fatigued performance* (Technical Report No. NAMRU-D-11-34).
- Chandler, J. F. (2011). *Predicting individual differences in response to sleep loss* (Research Information Bulletin Report No. NAMRU-D-11-46).
- Prabhakaran, K., Gunasekar, P. G., & Chapman G. D. (2011). α -Synuclein over expression enhances manganese-induced neurotoxicity through the NF- κ B-mediated pathway. *Toxicology Mechanisms and Methods*, 21, 435-443.
- Ortiz, P. A. (2011, July). *Evaluation of jet fuel induced hearing loss in rats (rattus norviticus)*. Presentation given at the USAFSAM-Occupational Environmental Health Working Group, WPAFB, OH.
- Patterson, F. (Producer). (2011). Cockpit Spatial Strategies. First video in series: *Pilot Spatial Disorientation: Recognition and Avoidance Training*.
- Phillips, J. B., Simmons, R. G., & Arnold, R. D. (2011). A single dose of armodafinil significantly promotes vigilance eleven hours post-dose. *Military Medicine*, 176, 833-839.
- Phillips, J. B. (2011). *Cognitive and perceptual performance effects of controlled exposure to acute hypoxic stress* (Research Information Bulletin Report No. NAMRU-D-11-45).

Commanding Officer's Corner

By CAPT Keith Syring

On September 2nd NAMRL closed its doors for the last time, concluding a year-long transition of Naval aeromedical research from NAS Pensacola to Wright-Patterson AFB. In the face of much speculation and concern about the BRAC realignment, and the daunting task of relocation, the NAMRL and NAMRU-D staffs have worked tirelessly to sustain our aeromedical research mission throughout the transition, and firmly root it in our new home in Ohio. The transition has presented many challenges to our staff members – moving their jobs and families, reestablishing laboratories, and integrating into the local research community, all while maintaining an active research portfolio focused on addressing crucial fleet needs. Now their dedication and hard work are paying off.

Several local partnerships have already been established, and we continue to pursue others. Recent exchanges with USAF 711th Human Performance Wing, Air Force Institute of Technology, Wright State Research Institute, and University of Dayton Research Institute highlight the key liaisons we are establishing in the local research community. Our outstanding aeromedical researchers and unique laboratory facilities offer an attractive partnership to local Air Force, academic, and industry partners. And, in partnering with such outstanding collaborators, NAMRU-D will ensure we provide our fleet customers the most effective research products and solutions possible.

I am thankful for the NAMRU-D staff's enthusiasm and diligence in the establishment of our new command. With the NAMRL disestablishment this month, I've focused on our aeromedical mission; however, our toxicology staff, though already a resident of Wright-Patterson, has also experienced a significant transition, reorganizing into NAMRU-D. Their dedication and professionalism have been equally important in the successful establishment of this new command. As we continue forward, I encourage all the active duty, civilian, and contract personnel working together for NAMRU-D to remain motivated and focused on establishing an active role within the local research community. Your commitment to the growth and development of the command has encouraged me, and as your Commanding Officer, I look forward to our bright future.



Captain Keith Syring, USN
Commanding Officer

Taking the Helm of Navy Medicine's Aeromedical & Environmental Health Research

NAMRU-D

Commanding Officer

CAPT Keith Syring, MSC, USN

Executive Officer

CDR Rita Simmons, MSC, USN



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